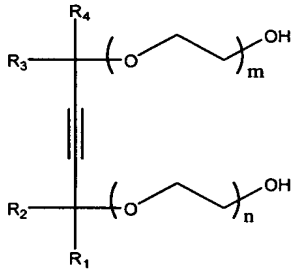
CLAIMS

We claim:

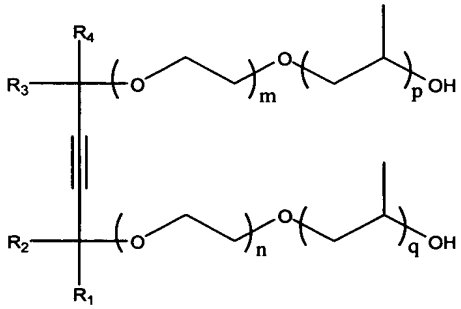
1. A method for reducing defects during the manufacture of semiconductor devices, the method comprising:

providing a post-CMP processed substrate wherein at least a portion of the substrate comprises a low dielectric constant film; and

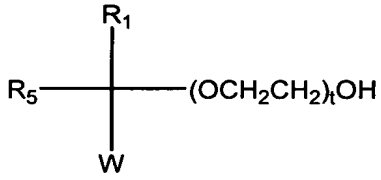
contacting the substrate with a process solution comprising about 10 ppm to about 500,000 ppm of at least one surfactant having the formula (I), (II), (III), (IVa), (IVb), (V), (VI), (VII):



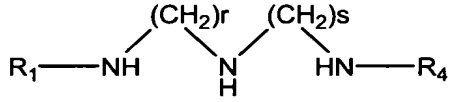
I



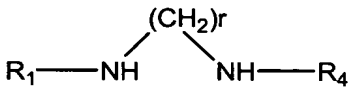
II



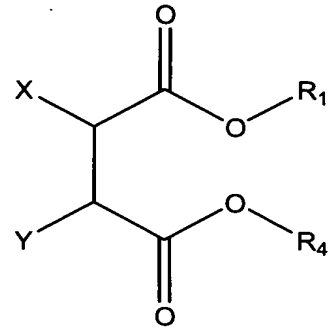
III



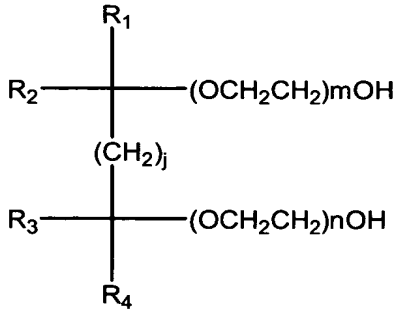
IVa



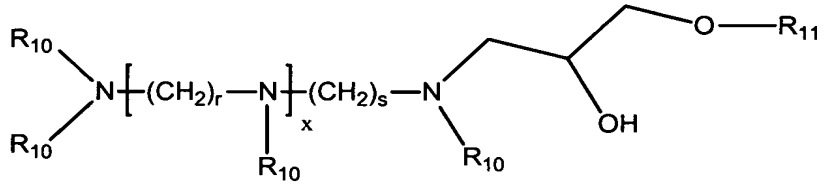
IVb



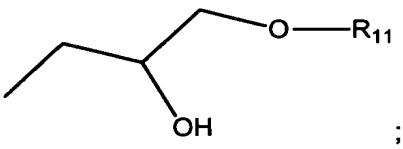
V



VI



VII

wherein R_1 and R_4 are each independently a straight or a branched alkyl group having from 3 to 10 carbon atoms; R_2 and R_3 are each independently a hydrogen atom or an alkyl group having from 1 to 5 carbon atoms; R_5 is a straight or a branched alkyl group having from 1 to 10 carbon atoms; R_{10} is independently H or a group represented by the formula  ; R_{11} is a straight, branched, or cyclic alkyl group having from 4 to 22 carbon atoms; W is a hydrogen atom or an alkynyl group; X and Y are each independently a hydrogen atom or a

hydroxyl group; m, n, p, and q are each independently a number that ranges from 0 to 20; r and s are each independently 2 or 3; t is a number that ranges from 0 to 2; j is a number that ranges from 1 to 5; and x is a number that ranges from 1 to 6.

2. The method of claim 1 wherein the process solution further comprises at least one acid.

3. The method of claim 1 wherein the process solution further comprises at least one base.

4. The method of claim 1 wherein the process solution further comprises at least one oxidizing agent.

5. The method of claim 1 wherein the process solution further comprises at least one chelating agent.

6. The method of claim 1 wherein the process solution further comprises at least one corrosion inhibitor.

7. The method of claim 1 wherein the process solution further comprises an additive selected from a stabilizer, a dissolving aid, a colorant, a wetting agent, an antifoamer, a buffering agent, a second surfactant, and combinations thereof.

8. The method of claim 1 wherein the contacting step comprises a dynamic rinse.

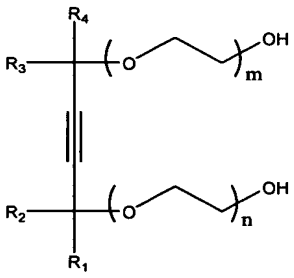
9. The method of claim 8 wherein the process solution exhibits a dynamic surface tension of about 45 dynes/cm^2 or less at 23°C and 1 bubble/second according to the maximum-bubble-pressure method.

10. The method of claim 9 wherein the process solution exhibits substantially zero foam at a time greater than 60 seconds.

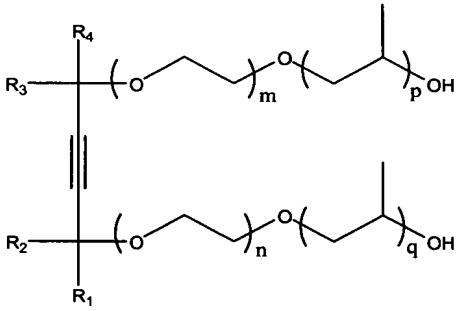
11. A method for reducing the defects during the manufacture of semiconductor devices, the method comprising:

providing a post-CMP processed substrate wherein at least a portion of a surface of the substrate comprises a low dielectric constant film;

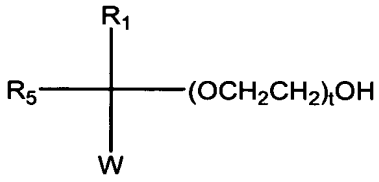
contacting the substrate with a process solution comprising at least one solvent and 10 ppm to about 500,000 ppm of at least one surfactant having the formula (I), (II), (III), (IVa), (IVb), (V), (VI), or (VII):



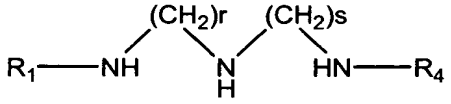
I



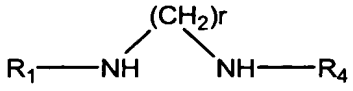
II



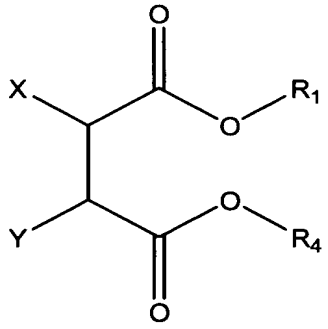
III



IVa



IVb



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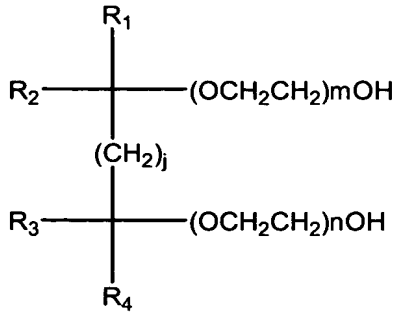
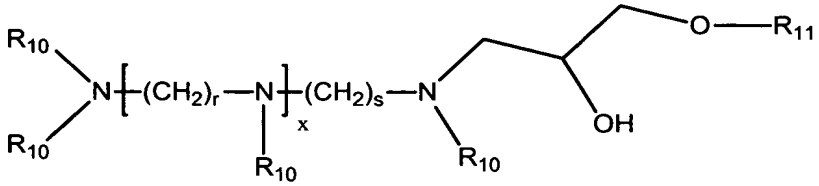
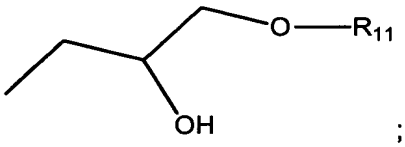


VI



VII

wherein R_1 and R_4 are each independently a straight or a branched alkyl group having from 3 to 10 carbon atoms; R_2 and R_3 are each independently a hydrogen atom or an alkyl group having from 1 to 5 carbon atoms; R_5 is a straight or a branched alkyl group having from 1 to 10 carbon atoms; R_{10} is independently H or a group represented by the formula  ; R_{11} is a straight, branched, or cyclic alkyl group having from 4 to 22 carbon atoms; W is a hydrogen atom or an alkynyl group; X and Y are each independently a hydrogen atom or a hydroxyl group; m, n, p, and q are each independently a number that ranges from 0 to 20; r and s are each independently 2 or 3; t is a number that ranges from 0 to 2; j is a number that ranges from 1 to 5; and x is a number that ranges from 1 to 6; and

rinsing the substrate with a deionized water rinse.

12. The method of claim 11 wherein the contacting step comprises a dynamic rinse.

13. The method of claim 11 wherein the contacting step comprises a static rinse.

14. The method of claim 11 wherein the surface of the substrate in the contacting step is wet with the deionized water rinse.

15. The method of claim 11 wherein the solvent comprises an aqueous solvent.

16. The method of claim 15 wherein the solvent comprises a non-aqueous solvent wherein the non-aqueous solvent is miscible in the aqueous solvent.

17. The method of claim 11 wherein the process solution is formed by injecting 10 to 500,000 ppm of the at least one surfactant into the solvent.

18. The method of claim 11 wherein the process stream is formed by applying 10 to 500,000 ppm of the at least one surfactant onto the surface of the substrate and applying the solvent to the substrate surface.

19. The method of claim 11 wherein the process stream is formed by passing the solvent through a cartridge comprising the at least one surfactant.

20. The method of claim 11 wherein the process stream is formed by diluting at least one surfactant with at least one solvent.

21. The method of claim 11 wherein a time of the contacting step ranges from 1 to 200 seconds.

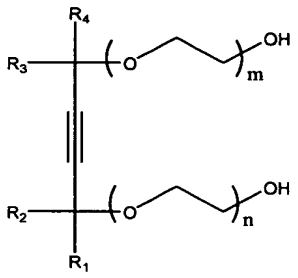
22. The method of claim 21 wherein the time of the contacting step ranges from 1 to 150 seconds.

23. The method of claim 22 wherein the time of the contacting step ranges from 1 to 40 seconds.

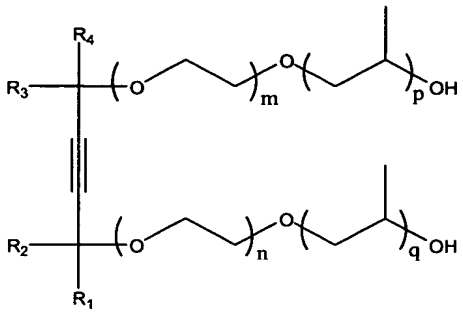
24. The method of claim 11 wherein an at least one temperature of the contacting step ranges from 10 to 100°C.

25. A process solution to treat a post-CMP processed substrate wherein at least a portion of the substrate surface comprises a low dielectric constant film, the solution comprising: at least one carrier medium selected from an aqueous solvent, a non-aqueous solvent, and combinations thereof and at least one

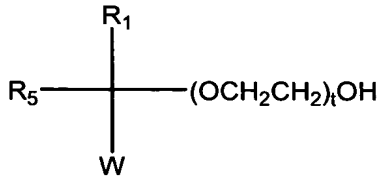
surfactant selected from the group of surfactants having the formula (I), (II), (III), (IVa), (IVb), (V), (VI), or (VII):



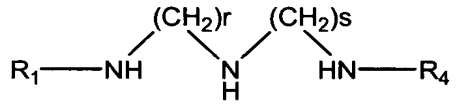
I



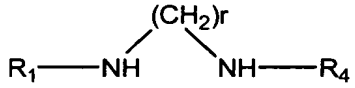
II



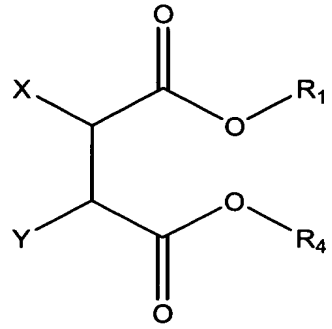
III



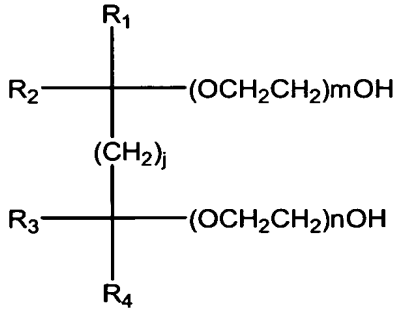
IVa



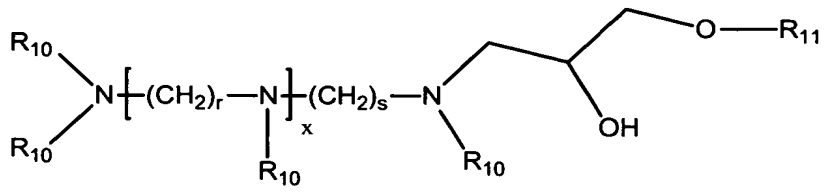
IVb



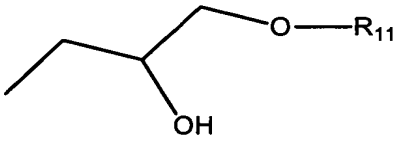
V



VI



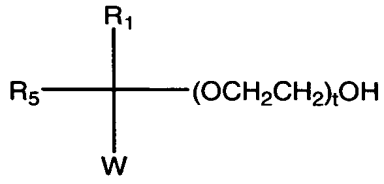
VII

wherein R_1 and R_4 are each independently a straight or a branched alkyl group having from 3 to 10 carbon atoms; R_2 and R_3 are each independently a hydrogen atom or an alkyl group having from 1 to 5 carbon atoms; R_5 is a straight or a branched alkyl group having from 1 to 10 carbon atoms; R_{10} is a hydrogen atom or a group represented by the formula  ; R_{11} is a straight, a branched, or a cyclic alkyl group having from 4 to 22 carbon atoms; W is a hydrogen atom or an alkynyl group; X and Y are each independently a hydrogen atom or a hydroxyl group; m and n are each independently a number that ranges from 0 to 20; r and s are each independently 2 or 3; t is a number that ranges from 0 to 2; j is a number that ranges from 1 to 5; and x is a number that ranges from 1 to 6.

26. The process solution of claim 25 wherein the at least one carrier medium comprises an aqueous solvent.

27. The process solution of claim 25 wherein the at least one carrier medium comprises a non-aqueous solvent.

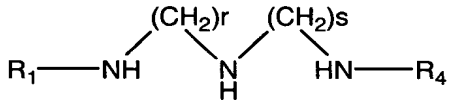
28. The process solution of claim 25 wherein the at least one carrier medium is an aqueous solvent and the at least one surfactant is a surfactant having the following formula (III):



III

wherein R_1 is a straight or a branched alkyl group having from 3 to 10 carbon atoms; R_5 is a straight or a branched alkyl group having from 1 to 10 carbon atoms; W is a hydrogen atom or an alkynyl group; and t is a number that ranges from 0 to 2.

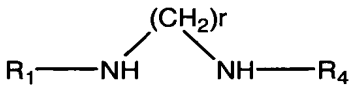
29. The process solution of claim 25 wherein the at least one carrier medium is an aqueous solvent and the at least one surfactant is a surfactant having the following formula (IVa):



IVa

wherein R_1 and R_4 are each independently a straight or a branched alkyl group having from 3 to 10 carbon atoms and r and s are each independently 2 or 3.

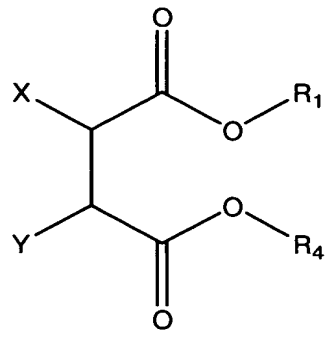
30. The process solution of claim 25 wherein the at least one carrier medium is an aqueous solvent and the at least one surfactant is a surfactant having the following formula (IVb):



IVb

wherein R_1 and R_4 are each independently a straight or a branched alkyl group having from 3 to 10 carbon atoms and r is 2 or 3.

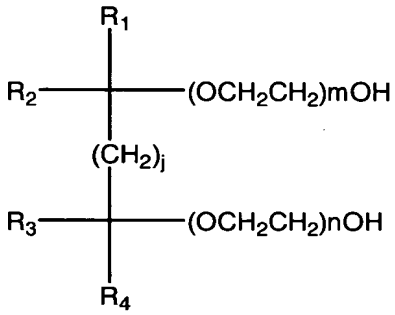
31. The process solution of claim 25 wherein the at least one carrier medium is an aqueous solvent and the at least one surfactant is a surfactant having the following formula (V):



V

wherein R_1 and R_4 are each independently a straight or branched alkyl group having from 3 to 10 carbon atoms and X and Y are each independently a hydrogen atom or a hydroxyl group.

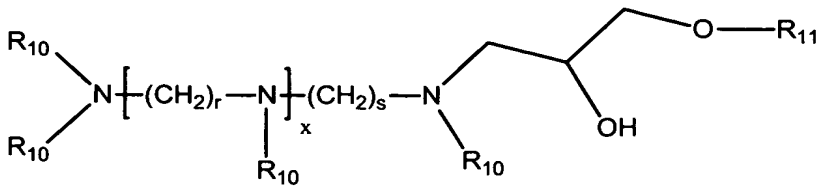
32. The process solution of claim 25 wherein the at least one carrier medium is an aqueous solvent and the at least one surfactant is a surfactant having the following formula (VI):



VI

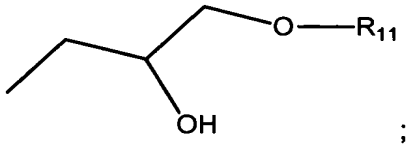
wherein R_1 and R_4 are each independently a straight or branched alkyl group having from 3 to 10 carbon atoms; R_2 and R_3 are each independently a hydrogen atom or an alkyl group having from 1 to 5 carbon atoms; m and n are each independently a number that ranges from 0 to 20; and j is a number that ranges from 1 to 5.

33. The process solution of claim 25 wherein the at least one carrier medium is an aqueous solvent and the at least one surfactant is a surfactant having the following formula (VII):



VII

wherein R_{10} is a hydrogen atom or a group represented by the formula



; R_{11} is independently a straight, branched, or cyclic alkyl group having from 4 to 22 carbon atoms; r and s are each independently 2 or 3; and x is a number that ranges from 1 to 6.